1-1-2016

Health For Achievement: Greater Health Assets Associated With Better Standards-Based Assessment Scores Among Eighth Grade Students

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Health for Achievement: Greater Health Assets Associated with Better Standards-based Assessment Scores among Eighth Grade Students

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ABSTRACT

Purpose: Improving adolescent health and educational attainment remain national priorities. However, major gaps remain in coordination of these efforts. Study objectives were to: (1) document associations between health assets and academic achievement, (2) examine cumulative effects of health assets on academic achievement, and (3) identify health assets most strongly associated with academic achievement.

Methods: Participants include 8th grade students attending 12 randomly selected schools (N=517, 75% of all eligible students). Data include physical measurements, student surveys, and school records, including standards-based assessment scores in literacy and mathematics. We assessed 20 health indicators covering three related domains of health as proposed by the Institute of Medicine: health conditions, functioning, and health potential. Health assets were measured in the Fall of 2014, preceding standardized testing which was conducted in the Spring of 2015.

Results: Students averaged 12 out of 20 possible health assets. Having more health assets was associated with greater likelihood of achieving goal on literacy and mathematics assessments (p <0.01 for both). Students with the most health assets had more than twice the likelihood of achieving goal on both assessments compared to students with the fewest (p <.05). Health assets most strongly associated with achieving goal on both assessments were having no chronic disease, having few conduct problems, and infrequently consuming unhealthy foods, fast-food meals, or sugar-sweetened beverages.

Conclusions: Health assets are associated with academic achievement among middle school students. Overall diet quality appears to be a prime candidate for intervention. Promoting health equity may contribute to closing the achievement gap.

Implications and Contribution: To date, limited research has examined the association between multiple health risk/protective factors and academic achievement. We found middle school students with more health assets are significantly more likely to achieve goal on standards-based literacy and mathematics assessments. Health promoting interventions may improve both health and academic outcomes.

Acknowledgements

I would first like to thank my thesis advisor, Dr. Jeannette Ickovics of the Yale University School of Public Health. Dr. Ickovics has provided me with thoughtful direction over the past several years and provided me significant guidance throughout the thesis process. She was always there to assist with any questions I ran into and has acted as a true mentor and role model.

I would also like to acknowledge Dr. Kathleen O'Connor Duffany of the Yale University School of Public Health as the second reader of this thesis. I am gratefully indebted to her for all of her wonderful feedback and invaluable insight throughout the thesis process.

I must also extend my gratitude to the many wonderful people involved in the Health for Achievement study. It was a pleasure working under the leadership of the Principal Investigators, Dr. Marlene Schwartz of the Rudd Center for Food Policy and Obesity and Dr. Ickovics. My thanks also extends to the staff at the Rudd Center for Food Policy and Obesity, administrators, teachers, students, their families, food service staff, interns, and researchers. Without their commitment to this endeavor I would not have had the pleasure of taking part in this project and would not have been able to complete a thesis on which I care so much about. This project would not have been possible without the funding generously provided by the National Institute for Child and Human Development (1R01 HD070740), the Patrick and Catherine Weldon Donaghue Medical Research Foundation, The Kresge Foundation, Emerging and Promising Practices, and the Aetna Foundation. This research was conducted in affiliation with Community Interventions for Health, Oxford Health Alliance, Oxford England.

Finally, I must express my very profound gratitude to my parents and to my partner for providing me with support and continuous encouragement throughout my years of study and through my thesis-writing journey. This accomplishment would not have been possible without them. Thank you!

Table of Contents

Section	Page(s)
Abstract	2-3
Acknowledgements	4
List of Tables	5
List of Figures	5
Introduction	6-7
Methods	7-12
Results	12-15
Discussion	15-19
Conclusions	19
References	20-22
Tables and Figures	23-28

List of Tables

Table 1 – Description of Study Variables
Table 2 – Description of sample and achievement of goal on standards-based literacy and/or mathematics assessment
Table 3 – Bivariate and Multivariate associations between study variables and achievement of goal on standards-based literacy and/or mathematics assessment

List of Figures

Figure 1 – Percent of students achieving goal on literacy and mathematics assessments by health assets
Figure 2 – Cumulative effect of health assets on standards-based assessment achievement

The connection between health and academic success is well known. Research has linked specific risk factors such as malnutrition, chronic disease, and physical inactivity to lower test scores and educational attainment.[1] While the majority of evidence consistently supports this association, there remains some disagreement regarding the direction of causality.[2] It is possible that the association may be bidirectional or multidirectional: education may impact health, health may influence education, and other factors may influence both. To date, few studies have examined the association of multiple health risk and protective factors with academic achievement.

The Institute of Medicine states that measuring adolescent health is challenging due to its dynamic nature and that assessment should encompass three domains of health: health conditions, functioning, and health potential.[3] *Health conditions* include acute or chronic disease or impairment of physical and psychosocial nature usually classified by the ICD system.[3] For example, obesity has been associated with decreased mental health, cognitive function, and school performance.[4-6] *Functioning* refers to the degree to which health conditions (e.g., symptoms, treatment) impact daily life.[3] For example, physical activity – which may be restricted due to an existing health condition or because of environmental constraints – is associated with cognitive benefits and reduced risk of chronic disease.[7] A recent systematic review found a significant association between physical activity and academic performance.[8] *Health potential* refers to attributes that contribute to one's resilience against threats to health. This can include an adolescent's ability to engage in positive interpersonal relationships and behaviors. Often the lack of these assets is associated with lowered achievement.[9]

Recent studies have incorporated a broad conceptualization of health. Ickovics *et al.* examined the association between a set of 14 modifiable health assets and academic

achievement among 5th and 6th grade students; the cumulative effect of health assets positively impacted academic achievement.[10] Authors concluded that schools should promote health in order to increase achievement. A similar study by Forrest *et al.*[11] concluded that good health may buffer children to adverse academic consequences related to the stresses of adolescence, school, and pubertal transition. And, in a study of Canadian students in 4th through 6th grade, unhealthy lifestyle behaviors were associated with poorer academic performance.[12]

This study replicates and extends prior research. We contribute to the small but growing body of evidence through the inclusion of 20 modifiable heath factors across the three domains of adolescent health. The objectives are to: (1) demonstrate the association between modifiable health assets and achievement on standards-based assessments; (2) explore the cumulative effect of health assets on academic achievement; and (3) identify which health assets are most strongly associated with academic achievement. We hypothesize that students with the most health assets will be significantly more likely to achieve academic success, as measured by achieving goal on standards-based assessments in English language arts/literacy (hereby referred to as 'literacy') and mathematics on the Connecticut Smarter Balanced Assessment. Results can inform priority areas for future targeted interventions.

Methods

Population

Data are from a multi-site cluster randomized controlled trial on obesity prevention conducted from 2011-2015. The study was administered through a partnership between the Community Alliance for Research and Engagement at the Yale School of Public Health, Rudd Center for Food Policy and Obesity, and New Haven Public

Schools. Twelve schools were randomly selected from 27 possible K-8 district schools. Schools were randomized to receive support for specific school wellness policies regarding nutrition and physical activity. For this study, data from all 8th grade students in participating schools were included (2014-2015 academic year). Predictor variables were measured in Fall 2014, prior to completion of academic assessments administered in Spring 2015. All procedures were approved by the Yale University Human Subjects Committee and the New Haven Public Schools Board of Education. Both child assent and parental consent were obtained in English or Spanish.[10]

There were 688 8th grade students eligible for participation, 107 students opted out or were absent during data collection. Of the remaining 581 students, we excluded those who lacked standards-based assessment scores and students missing three or more health asset measures (n=64). There were 517 students included in the analyses, representing 75% of all 8th grade students in the 12 schools.

Students ranged from 12-15 years of age with mean age 13.7 years. Girls comprised 54.0% of participants. Ethnic/racial background of students was 47.8% Hispanic, 32.5% African American, and 19.7% White or other race/ethnicity, reflecting the distribution in the school district.

Procedures and Measurement

School District Records: Academic Achievement and Socio-demographic Characteristics. Academic achievement was assessed using the Connecticut Smarter Balanced Assessment, which included sections for literacy and mathematics. Assessments are aligned to Common Core State Standards and were administered to all students in grades 3-8. Scores reflect the first operational assessment[13] and correspond to four levels of achievement: (1) does not meet achievement level, (2) approaching achievement level,

(3) meets achievement level, and (4) exceeds achievement level.[14] Students earning a score corresponding to Level 3 or 4 on mathematics and literacy were coded as having achieved goal on the subject-specific assessment. Those achieving goal on both the literacy and mathematics assessments were coded as having achieved goal on both assessments. Scores were obtained from the district administrative database.

Students' age, sex, race/ethnicity, and number of absences were obtained from the district administrative database. Given low representation of students with a race/ethnicity other than Black and Hispanic, students with other race/ethnicities were combined into White/other for analyses.

Physical Measurements. Height, weight, and blood pressure were collected by trained researchers following World Health Organization[15] and American Heart Association Guidelines[16] in Fall 2014.

Student Surveys/Health Index. Surveys were administered in Fall 2014. Data collection methods have been described previously.[10,17] In brief, surveys regarding personal health, health behaviors, and environmental factors were completed by students during school hours on desktop computers while research staff read the questions aloud (Surveymonkey.com, LLC, Palo Alto, CA).

A composite score, referred to as the ***health index***, was comprised of 20 health assets across the three health domains as categorized by the Institute of Medicine: health conditions, functioning, and health potential. Indicators for the health index were obtained from physical measures and responses to the student survey. For each student, health assets were scored as 0/1 and then summed to calculate the health index with a possible range of 0-20. This score was then split into tertiles: low, medium, and high to

examine the cumulative effects of health. Table 1 describes each health asset, including measurement source.

Health Conditions. Five health assets measured health conditions. 'No chronic disease' indicates that the student had normal blood pressure and no history of diabetes or asthma. 'Healthy body mass index' indicates that the student's measured body mass index was <85th percentile based on age- and sex-adjusted Centers for Disease Control and Prevention growth charts.[18] The Strengths and Difficulties Questionnaire[19] is commonly used as a behavioral/psychiatric disorder screener.[20] Three subscales were included here as indicators of health conditions: conduct problems, hyperactivity, and emotional problems. Having the health asset for each subscale indicates that the student had a score corresponding to 'close to average' versus an elevated score.

Functioning. Four health assets measured functioning. Two indicators of functioning are derived from the two additional subscales of the Strengths and Difficulties Questionnaire as described above: prosocial behavior and peer problems. 'Meets physical activity recommendations' corresponds to the 2008 Physical Activity Guidelines for Americans[7] by being active for at least 60 minutes 3 or more days per week. 'Quality sleep' indicates that the student reported not having difficulty getting to sleep.

Health potential. Eleven health assets measured health potential. 'No television in the bedroom' indicates that the student complied with the recommendation by the American Academy of Pediatrics[21] and reported not having a television in their bedroom. 'Meets screen time recommendations' corresponds to the student reporting no more than two hours of screen time for fun per weekday in compliance with the American Academy of Pediatrics recommendation.[21] 'Never smoked' indicates that the student had never tried cigarette smoking. 'Food secure' indicates that the student reported never worrying about

food running out, eating less, or not eating because there was not enough food at home. 'Eats healthy foods' indicates that a student reported eating at least five of seven possible healthy foods/beverages on the student survey, corresponding to the highest tertile of the sample in the absence of a standard cutoff. 'Eats few unhealthy foods' indicates that a student reported eating no more than 2 of a possible 11 unhealthy foods/beverages, corresponding to the median split in the absence of a standard cutoff. 'Eats few fast-food meals' indicates that a student reported eating a fast-food meal no more than one day during the past week. 'Drinks few sugar-sweetened beverages' indicates that a student reported drinking sugar-sweetened beverages on no more than two days in the past week. 'Regular family meals' corresponds to children eating a meal together with all or most live-in family members at least five times in the past week, complying with the recommendation by the American Medical Association. [22] 'High school connectivity' indicates that students received a score corresponding to an average of 'agree' or 'strongly agree' with six questions gauging school connectivity. 'Feels safe in neighborhood' corresponds to students feeling safe all of the time when outside in their neighborhood.

Data Analyses

To achieve the first aim of the study, chi-square and Fisher's exact tests were conducted to examine the associations between each health asset and achieving goal on literacy, mathematics, and both assessments. For assets associated with achievement, logistic regression was used to examine the odds of achieving goal among those with a particular asset versus those without. To achieve the second aim of the study, multivariate logistic regression was used to examine the association between academic achievement and health as both a continuous and categorical variable, using the health index and

health index tertiles, respectively. Multivariate models were adjusted for age, sex, race/ethnicity, and number of absences. All regression analyses accounted for intra-class correlation within schools due to the cluster-randomized design of the primary study.

To achieve the third aim of the study, the impacts of individual health assets were examined in relation to one another and relevant covariates using multivariate logistic regression models to determine which health assets were most strongly associated with academic achievement. Models were compared using the quasi-likelihood under the independence model criterion statistic (QICu), which is used for comparing model fit while considering parsimony.[23,24] Models with the smaller statistic are preferred. One model contained all covariates (age, race/ethnicity, sex, and absences) and no health assets. Additionally, a full model contained all covariates and all health assets associated with achieving goal with a significance level of <0.10. Backwards elimination was used to eliminate assets one at a time (while maintaining covariates in the model) to determine which remained significant. All analyses were conducted with SAS 9.4 (SAS Institute Inc., Cary, NC).

Results

Achievement on Standards-based Assessments

Table 2 provides achievement on the standards-based assessments by sociodemographic characteristics. Overall, 38.1% of students in the analytic sample achieved goal in literacy, 11.4% achieved goal in mathematics, and 9.9% achieved goal on both assessments. These numbers are comparable to the district average scores, though well below state average scores of 54.0% in literacy and 36.8% in mathematics.[14] Females and students of White/other race/ethnicity were more likely to achieve goal on both assessments as were younger students and students with fewer absences (all p <.05).

Health Index

Of the 20 health assets, students reported an average of 11.6 assets (SD=3.0), with a range of 3-20. The distribution of each health asset can be seen in Table 3.

Association of Health Assets and Achievement

Figure 1 provides results for the first aim of the study and illustrates the percentage of students achieving goal on literacy and mathematics assessments by each health index item individually. Health assets significantly associated with achieving goal on each individual assessment were: no chronic disease, few conduct problems, normal prosocial behavior, no television in the bedroom, few unhealthy foods, and few fast-food meals. Additionally, never smoked and food secure were significantly associated with greater achievement on literacy and eating healthy foods was inversely associated. Drinking few sugar-sweetened beverages was associated with achievement on mathematics.

Table 3 shows unadjusted and adjusted odds ratios [AOR] for academic achievement on literacy, mathematics, and both assessments for all covariates and 10 health assets that were associated with any outcome. Students without chronic disease were more than twice as likely to achieve goal on both assessments (odds ratio [OR], 2.60; 95% confidence interval [CI], 1.61-4.19). Regarding measures from the Strengths and Difficulties Questionnaire, those with few conduct problems and normal prosocial behavior were almost three times more likely to achieve goal on each and both assessments (all p <.05). All three measures related to the consumption of unhealthy foods and beverages were significantly related to achievement on both assessments, with ORs ranging from 2.63 to 4.49 (all p <.001).

Achievement by Health Index

Students with a higher health index score were significantly more likely to achieve goal on literacy and mathematics assessments– regardless of which assets were present, and even after controlling for confounding variables including age, race/ethnicity, sex, and number of absences. Each additional health asset is associated with a 19% increase in the likelihood of achieving goal on both assessments (AOR, 1.19; 95% CI, 1.07-1.32). Each additional health asset was associated with an 11% and 18% increase in the likelihood of achieving goal on literacy and mathematics, respectively (AOR, 1.11; 95% CI, 1.04-1.18; AOR, 1.18; 95% CI, 1.06-1.31).

A greater proportion of students in the highest tertile of health assets achieved goal on both assessments. Specifically, 16.3% of students in the highest tertile achieved goal, compared to 5.9% and 5.6% for those in the low and middle tertiles, respectively. Students in the highest tertile had more than twice the likelihood of achieving goal on both assessments compared to those in the lowest (AOR, 2.36; 95% CI, 1.03-5.40). This association is illustrated in Figure 2. Examining test scores independently, students with the most health assets were twice as likely to achieve goal in mathematics compared to those with the fewest (AOR, 2.03; 95% CI, 1.02-4.04). However, students having the most health assets were not significantly more likely to achieve goal in literacy compared to students with the fewest (AOR, 1.62; 95% CI, 0.93-2.84).

Health Assets of Most Significance to Academic Achievement

Compared to a model containing all relevant covariates and an adjusted model containing eight health assets shown to increase the likelihood of achieving goal on both assessments, a more parsimonious model containing only five health assets was shown to be almost equally predictive of achievement. These assets were: no chronic disease, few

conduct problems, few unhealthy foods, few fast-food meals, and few sugar-sweetened beverages. Final model results are shown in the last column of Table 3.

Discussion

This study contributes to a deeper understanding of the association between individual health assets and academic achievement. Five health assets proved to be of particular importance in predicting achievement: no chronic disease, few conduct issues, few unhealthy foods, fast-food meals, and sugar-sweetened beverages. Further, regardless of the *specific* health asset, simply having *more* assets (as measured by the composite health index score) was significantly associated with a greater chance of achieving goal on standards-based assessments in literacy and mathematics even after adjusting for important covariates such as race/ethnicity and absences. Each additional asset resulted in a 19% higher likelihood of achievement on both assessments.

Results are consistent with prior studies[10,12,25] both in association and magnitude. The magnitude of the relationship between achievement and each additional asset among this cohort of students in grade 8 is extremely consistent with the one seen in a previous study conducted among students in grades 5 and 6 (AOR, 1.19; 95% CI, 1.07-1.32 *vs* AOR, 1.18; 95% CI, 1.08-1.29).[10] Unfortunately, much of the research on health and achievement has focused on individual health assets while failing to measure the cumulative effects of health. Results may vary from study to study when focusing on a single health factor as many influential factors are inextricably linked. To this point, one study examining measures of psychological well-being found that results differed whether factors were considered individually or simultaneously with other factors.[9]

Findings from our study differ somewhat from prior studies regarding individual assets. For example, food security was significantly related to achievement in literacy but

not mathematics, which differs from other studies linking food insufficiency with lower scores in mathematics.[26] And while recent evidence regarding the association between physical activity and academic outcomes has been mixed, [2,27,28] our study failed to demonstrate a relationship between meeting physical activity recommendations and academic achievement. Perhaps this is because physical activity is in itself a multifactorial variable encompassing frequency, intensity, and social factors. For example, studies that examined participation in sports proposed that the positive effect on academia may be explained by team or social status rather than physical activity itself.[29-31] Additional studies that consider the multidimensional nature of health in relation to different outcomes are needed.

Students engage in numerous behaviors and are exposed to environments that may adversely affect their health and consequently (or concurrently) their academic achievement. For example, less than one-half of students met screen time recommendations, and more than three-quarters of students reported having a television in their bedroom. Despite this factor being easily modifiable, with the current ubiquity of smartphones, the presence and use of screens in the bedroom is almost certain to rise. This will likely adversely impact the amount and quality of sleep, which may be one mechanism by which screen time and academic achievement are linked.[32] These behaviors and environmental factors represent opportunities for intervention.

Study outcomes were standards-based assessments administered to students statewide for the first time. Along with the introduction of a new standards-based assessments aligned to more rigorous standards, state officials expected a decline in scores from previous years.[33] However, this group of students fared well-below state averages with less than 10% achieving goal in both literacy and mathematics. Clearly,

intervention will be required to assist students toward high school graduation and to produce college-ready students. As district leaders make policy decisions with the intention of improving test scores, they should be mindful of the health-achievement connection. As Basch has stated, "Healthier students are better learners."[34]

Coordinated efforts to improve educational attainment must include attention to student health in order to be sufficiently effective. A recent systematic review regarding the effectiveness of the World Health Organization's Health Promoting Schools framework concluded that interventions aimed at specific health factors such as physical activity and diet can potentially produce population-level changes.[35] Implementing effective interventions geared towards different domains of health stands to improve both health and achievement.

While five assets were identified as having the strongest association with achievement among these students, further research into the multidimensional nature of health must continue to examine other relevant factors. Furthermore, certain health assets may be determined during a sensitive or critical period prior to school age while others may remain modifiable throughout adolescence. For example, certain events produce irreversible disease (e.g., type I diabetes, asthma, spina bifida) and, therefore, intervention during adolescence for these illnesses would aim only to ameliorate symptoms.[3] If particular irreversible health assets were found to be strongly associated with outcomes such as academic achievement, this could potentially catalyze early-childhood interventions targeting the prevention of the related risk factor(s). Additionally, while factors such as maternal diet during pregnancy and child nutrition through the first two years of life have lasting impacts on health and IQ,[36] diet throughout adolescence

continues to influence health and educational outcomes.[37] There are several other aspects of health that warrant attention throughout the lifecycle.

Limitations and Strengths

The lack of a significant association between particular health assets and academic achievement should be interpreted with caution. A combination of underlying cluster-randomization, dichotomization of health assets, and low number of students achieving goal on both assessments may have reduced the power to detect a relationship that exists. Additionally, some important health factors of a more sensitive nature such as drug use or sexual activity, which have been shown to be related to academic outcomes,[38,39] were not included in this student survey. We were unable to control for household income. However, food security is related to household income and was one of the health assets examined in the analyses and health index. We tested meal status and food security as possible control variables in the regression models, but neither significantly impacted results and both reduced the fit of the model.

Study strengths include having individual-level data from a diverse sample of urban school students. While results may not be generalizable to all adolescents, they may be generalizable to other settings with high rates of Black and Hispanic youth in school districts experiencing disparities in academic achievement. Another study feature was the comprehensive measure of health, which included objective physical measurements and detailed self-reported information. Associations between health assets and academic achievement were adjusted for confounding variables such as race/ethnicity and absenteeism. Results also included a cumulative measure of health and the relationship of specific health assets and achievement controlled for other assets.

Additionally, health assets were measured in Fall 2014 prior to completion of academic assessments in Spring 2015, resulting in temporally ordered data.

Conclusions

Greater health is associated with academic achievement among middle school students. Aiming to promote health equity may help close the achievement gap. This information may be particularly relevant to districts with under-performing schools that are deciding whether to keep or introduce health-promoting features of the school environment while trying to improve academic rigor. Schools are poised to play a major role in promoting health. Interventions aimed at improving health have the potential to improve academic achievement.

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Table 1
Description of health assets

Health Assets						
Name	Categories/description	Source of Question	Guideline for Cutoff	Source of Data		
				Student Survey	Physical Measurement	District Database
Health Conditions						
No chronic disease	1) Had normal blood pressure per physical measurements, 2) reported 'no' to the question: *Has a doctor or nurse ever told you that you have diabetes?*, and 3) reported 'no' to the question: *Has a doctor or nurse ever told you that you have asthma?*	Centers for Disease Control and Prevention (CDC). National Health Interview Survey. 2016; http://www.cdc.gov/nchs/nhis.htm. Duffany KOC, Finegood DT, Matthews D, et al. Community Interventions for Health (CIH): A novel approach to tackling the worldwide epidemic of chronic diseases. CVD Prevention and Control. 2011;6(2):47-56.		x	x	
Healthy body mass index	Body mass index categorized at less than the 85th percentile		CDC age- and sex-adjusted growth charts		x	
Few conduct problems	Scored "close to average" out of the categories: close to average, slightly raised/lowered, high/low, and very high/low.	Goodman R. The Strengths and Difficulties Questionnaire: a research note. Journal of child psychology and psychiatry. 1997;38(5):581-586.	Four-band categorization	x		
Normal hyperactivity				x		
Few emotional problems				x		
Functioning						
Normal prosocial behavior	Scored "close to average" out of the categories: close to average, slightly raised/lowered, high/low, and very high/low.	Goodman R. The Strengths and Difficulties Questionnaire: a research note. Journal of child psychology and psychiatry. 1997;38(5):581-586.	Four-band categorization	x		
Few peer problems				x		
Meets physical act. rec's	Answered ≥ 3 days to the survey question: *How many days do you do a physical activity for 60 minutes or more?*	Patient Centered Assessment and Counselling for Exercise. Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. Archives of pediatrics & adolescent medicine. 2001;155(5):554-559	2008 Physical Activity Guidelines for Americans	x		
Quality sleep	Responded 'not true' to the survey statement: *You have difficulties getting to sleep.*			x		
Health Potential						
No television in bedroom	Answered 'no' to the survey question: *Do you have a TV in your bedroom?*	CDC. Global School-based Student Health Survey (GSHS). 2016; http://www.cdc.gov/gshs/questionnaire/index.htm.	American Academy of Pediatrics	x		
Meets screen time rec's	Reported watching TV or DVD's, playing video games, and spending time on the computer/smart phone for fun ≤2 hours per weekday.	CDC. GSHS. 2016; http://www.cdc.gov/gshs/questionnaire/index.htm.	American Academy of Pediatrics	x		
Never smoked	Reported 'no' to the survey question: *Have you ever tried cigarette smoking, even one or two puffs?*	CDC. Global Youth Tobacco Survey - Overview. 2016; http://www.cdc.gov/tobacco/global/.		x		
Food Secure	Reported 'never true' to the survey questions: *I felt worried that our food at home would run out before we could get more; I ate less than I wanted to because there wasn't enough food at home; and I was hungry, but didn't eat because there wasn't enough food at home.*	U.S. Household Food Security Survey Module for self-administration. Connell CL, Nord M, Lofton KL, Yadrick K. Food security of older children can be assessed using a standardized survey instrument. The Journal of nutrition. 2004;134(10):2566-2572.		x		

Eats healthy foods	Reported eating ≥5 of 7 possible healthy foods/beverages (top tertile).	University of California Berkeley Center for Weight and Health. Healthy Eating, Active Communities Student Nutrition and Physical Activity Student Survey. 2014; http://www.farmtoschool.org/Resources/HEAC%20survey%20form-2.pdf.		x
Eats few unhealthy foods	Reported eating ≤2 of a possible 11 unhealthy foods/beverages on the previous day (lower half of median split).			x
Eats few fast-food meals	Answered ≤1 day to the question: I*n the past 7 days, how many days did you eat at a fast food restaurant such as McDonald's, Popeye's, Kentucky Fried Chicken, or Burger King?*	CDC. GSHS. 2016; http://www.cdc.gov/gshs/questionnaire/index.htm.		x
Drinks few sugar-sweetened beverages	Answered ≤2 days to the question: *In the past 7 days, how many days did you drink a sugar-sweetened beverage?*	Roberts C, Freeman J, Samdal O, et al. The Health Behaviour in School-aged Children study: methodological developments and current tensions. International Journal of Public Health. 2009;54(2):140-150.		x
Regular family meals	Answered ≥5 times to the survey question: *During the past 7 days, how many times did all or most of your family living in your house eat a meal together?*	Project EAT at University of Minnesota. Epidemiology & Community Health Research: Project EAT Survey. 2016; http://www.sphresearch.umn.edu/epi/project-eat/.	American Medical Association	x
High school connectivity	Received a score corresponding to an average of 'agree' or 'strongly agree' with six questions gauging school connectivity.	School Connectedness Scale. Resnick MD, Bearman PS, Blum RW, et al. Protecting adolescents from harm: findings from the National Longitudinal Study on Adolescent Health. JAMA. 1997;278(10):823-832.		x
Feels safe in neighborhood	Reported 'yes, all of the time' to the survey question: *Do you feel safe when you are outdoors in your neighborhood?*	Sastry N, Ghosh-Dastidar B, Adams J, Pebley AR. The design of a multilevel survey of children, families, and communities: The Los Angeles Family and Neighborhood Survey. Social Science Research. 2006;35(4):1000-1024.		x

Table 2
Description of sample and achievement of goal on standards-based literacy and/or mathematics assessment in 8th grade, N=517

Characteristic	Total % (N)	% (n) Achieved Goal		
		Literacy 38.1 (197)	Mathematics 11.4 (59)	Both 9.9 (51)
Race/ethnicity		***	***	***
White/other[a]	19.7 (102)	56.9 (58)	30.4 (31)	28.4 (29)
Black	32.5 (168)	31.6 (53)	4.8 (8)	4.2 (7)
Hispanic	47.8 (247)	34.8 (86)	8.1 (20)	6.1 (15)
Gender		***	*	***
Male	47.0 (243)	22.6 (55)	7.8 (19)	5.4 (13)
Female	54.0 (274)	51.8 (142)	14.6 (40)	13.9 (38)
Age (years ± SD)	13.7 ± 0.5	13.6 ± 0.4***	13.5 ± 0.4***	13.5 ± 0.4***
Absences (days ± SD)	10.4 ± 9.2	9.2 ± 7.6 **	8.0 ± 5.3**	7.8 ± 5.3*

Table values are mean ± standard deviation (SD) for continuous variables and row % (n) for categorical variables.
Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.
*p <.05, ** p <.01, p <.001, p -value is for t-test (continuous variables) or chi-square test (categorical variables).
[a] White and other were combined; analysis revealed similar achievement levels between groups.

Table 3
Bivariate and Multivariate associations between study variables and achievement of goal on standards-based literacy and/or mathematics assessment in 8th grade (N=517)

	Total	Literacy		Mathematics		Both		
	% (n)	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Final Adjusted Model
Health Index Tertiles								
Tertile 1 (low): 3-9 assets	26.1 (135)	1 (ref)		1 (ref)		1 (ref)		
Tertile 2 (medium): 10-12 assets	34.6 (179)	1.18 (0.77-1.80)		0.91 (0.40-2.09)		0.96 (0.30-3.01)		
Tertile 3 (high): 13-20 assets	39.3 (203)	1.54 (0.95-2.48)		2.74 (1.49-5.04)**		3.00 (1.39-6.45)**		
Health Index Score (mean ± SD)	11.6 ± 3.0	1.10 (1.04-1.16)***	1.11 (1.04-1.18)**	1.25 (1.12-1.39)***	1.18 (1.06-1.31)**	1.26 (1.14-1.39)***	1.19 (1.07-1.32)**	
Race/ethnicity								
White/other	19.7 (102)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Black	32.5 (168)	0.38 (0.21-0.70)**	0.50 (0.28-0.89)*	0.11 (0.05-0.25)***	0.16 (0.08-0.32)***	0.11 (0.05-0.24)***	0.14 (0.07-0.30)***	0.17 (0.08-0.39)***
Hispanic	47.8 (247)	0.55 (0.38-0.80)**	0.68 (0.47-0.98)*	0.20 (0.11-0.38)***	0.24 (0.13-0.45)***	0.16 (0.08-0.32)***	0.20 (0.10-0.41)***	0.17 (0.07-0.40)***
Gender								
Male	47.0 (243)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Female	53.0 (274)	3.40 (2.10-5.51)***	3.40 (2.12-5.44)***	2.00 (1.00-4.01)	1.55 (0.84-2.84)	2.78 (1.50-5.14) **	2.27 (1.31-3.92)**	2.29 (1.24-4.23)**
Age (mean ± SD)	13.7 ± 0.5	0.45 (0.32-0.63)***	0.51 (0.35-0.74)***	0.31 (0.16-0.61)***	0.37 (0.18-0.75)**	0.37 (0.22-0.64)***	0.46 (0.26-0.81)**	0.40 (0.23-0.70)**
Absences (days ± SD)	10.4 ± 9.2	0.98 (0.96-0.99)**	0.98 (0.96-1.01)	0.95 (0.91-0.99)*	0.95 (0.90-0.99)*	0.95 (0.90-1.00)	0.94 (0.89-1.00)	0.94 (0.87-1.00)
Health Conditions								
No chronic disease	56.2 (286)	1.40 (0.99-1.99)		2.23 (1.47-3.37)***		2.60 (1.61-4.19)***		2.44 (1.34-4.45)**
Few conduct problems	76.6 (396)	2.89 (1.75-4.76)***		2.96 (1.27-6.87)*		3.04 (1.18-7.80)*		2.85 (1.12-7.30)*
Functioning								
Normal Prosocial behavior	64.6 (334)	2.45 (1.60-3.76)***		2.58 (1.00-6.62)*		3.63 (1.34-9.82)*		
Health Potential								
No TV in bedroom	18.1 (93)	1.82 (0.96-3.44)		2.33 (1.04-5.18)*		2.38 (0.98-5.77)		
Never smoked	92.3 (477)	4.66 (1.59-13.68)**		5.52 (0.85-36.04)		--		
Food Secure	72.7 (372)	1.52 (1.13-2.04)**		1.95 (0.85-4.46)		2.09 (0.92-4.72)		
Eats healthy foods	35.8 (185)	0.65 (0.43-0.98)*		0.86 (0.44-1.68)		0.84 (0.43-1.61)		
Eats few unhealthy foods	42.0 (217)	1.72 (1.32-2.24)***		2.84 (1.92-4.20)***		2.63 (1.63-4.22)***		1.79 (1.00-3.19)*
Eats few fast-food meals	62.2 (318)	2.53 (1.90-3.37)***		5.30 (2.45-11.52)***		4.49 (2.03-9.44)***		2.59 (1.22-5.50)*
Drinks few SSBs	34.1 (175)	0.91 (0.56-1.50)		3.14 (1.81-5.42)***		3.12 (1.77-5.51)***		1.99 (1.11-3.57)*

Table values are odds ratios (95% confidence interval)
SD = standard deviation
*p <.05, ** p <.01, p <.001, p -value corresponds to odds ratios. Adjusted odds ratios adjusted for age, race/ethnicity, sex, and absences. All analyses adjusted for school clustering.
SSBs = Sugar-sweetened beverages
Only variables that were shown to be associated according to chi-square tests are included in this table.

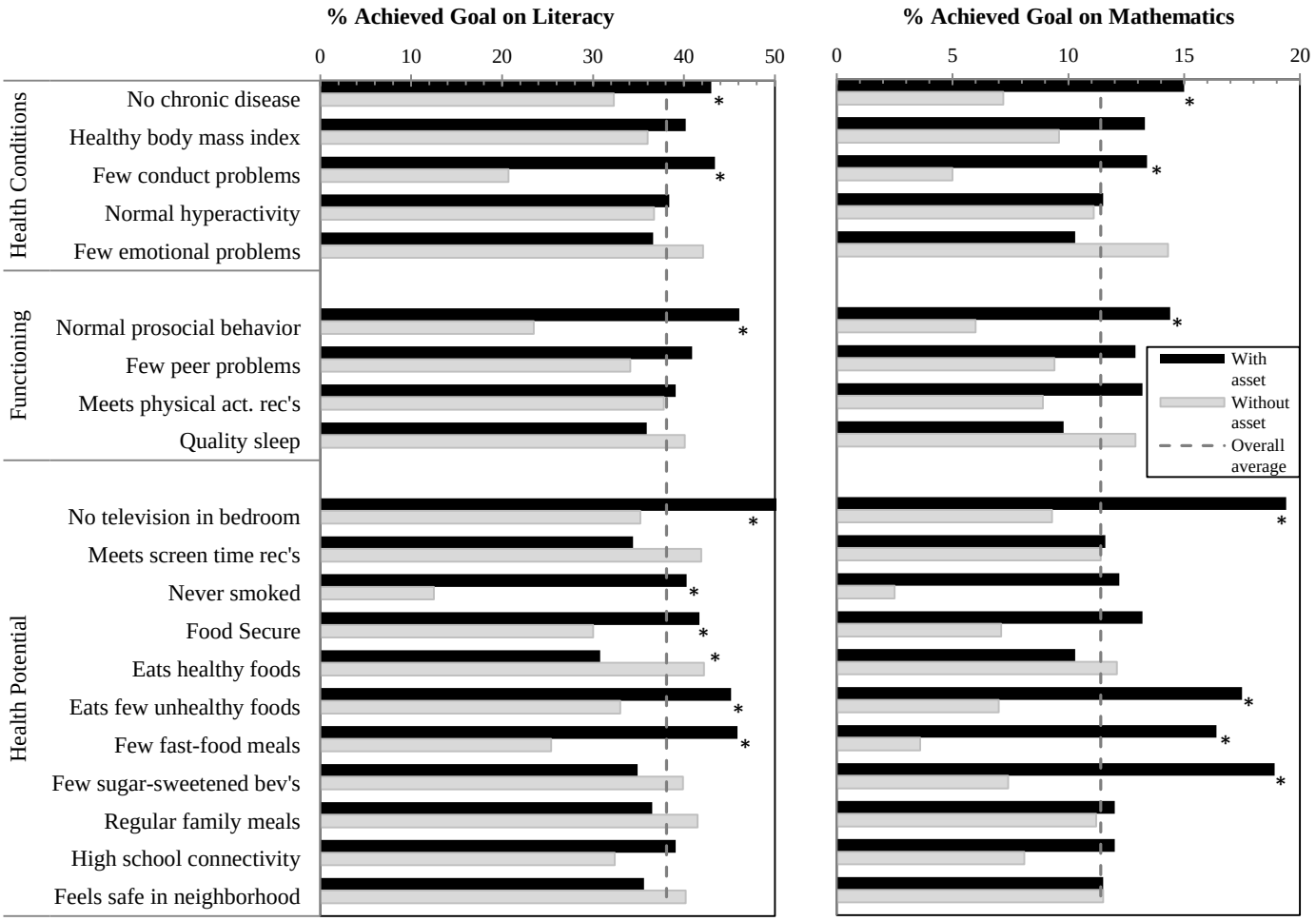

Figure 1. Percent of students achieving goal on literacy and mathematics assessments by individual health assets, N=517.
*p <.05, p -value is for chi-square or Fisher's exact test.

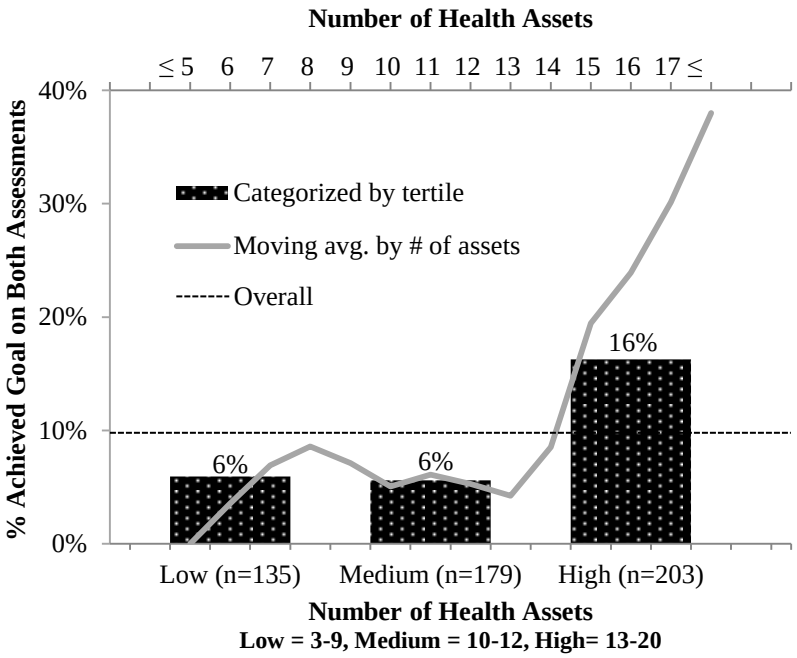

Figure 2. Cumulative effect of health assets on standards-based assessment achievement, N=517. Although the possible range for the health index score was from 0-20, the range was limited from 3-20 as no students reported fewer than 3 assets. The upper and lower ends of the data were winsorized as there were few students at the extreme ends of the range.